



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
WASHINGTON, D.C. 20460

OCT 17 1990

OFFICE OF  
WATER

MEMORANDUM

SUBJECT: Determination of "Hazardous Levels" for "No Migration" Demonstrations Pursuant to 40 CFR Section 148.20; Underground Injection Control Guidance No. 71.

FROM: Michael B. Cook, Director  
Office of Drinking Water (WH-550)

TO: Water Management Division Directors  
Water Supply Branch Chiefs  
UIC Section Chiefs  
EPA Regions I-X

BACKGROUND

Petitioners for exemptions from EPA's prohibitions on underground injection of hazardous waste must demonstrate that waste constituents will not migrate from the injection zone at "hazardous levels." See 40 CFR §148.20(a). The preamble to EPA's framework regulation described the general procedures for establishing "hazardous levels" for each waste constituent. See 53 Fed. Reg. 28,119, 28,122-23 (July 26, 1988). The purpose of this guidance is to further outline the procedure for establishing "hazardous levels" in the petition process.

"Hazardous Levels" Based on "Health-based Levels"

The first step toward establishment of a "hazardous level" for a particular hazardous waste constituent is to determine whether an EPA "health-based level" applies to the constituent. The sources of "health-based levels" are Safe Drinking Water Act Maximum Contaminant Levels, ambient water quality criteria development pursuant to Clean Water Act §304(a), and health-based limits based on verified reference doses developed by EPA's Risk Assessment Forum and site-specific Agency-approved public health advisories issued by ATSDR. See 52 Fed. Reg. 32,446, 32,453-54 (August 27, 1987). This office has developed a comprehensive listing of these "health-based levels," entitled "Concentration Limits Applicable to 'No Migration' Petitions for Injection of Hazardous Wastes", which is contained along with additional explanatory materials accompanying this guidance. This listing should be used as a starting point. The listing, however, is not binding on EPA and the Agency must assess and respond to comments concerning which level is appropriate.



"Hazardous Levels" Based on Information From Petitioner or Public Comment

When the listing does not contain a "health-based level" for a particular hazardous constituent, the petitioner may, but need not, submit toxicology studies that will allow EPA to designate a case-specific level for the constituent. The case-specific level will serve as the "hazardous level" in the "no migration" demonstration. The petitioner may propose a case-specific level for a hazardous constituent, based on the petitioner's analysis of the toxicology data. EPA will review and analyze the data to determine whether the data are sufficient to establish a case-specific level. The procedure that should be used to establish a case-specific level based on the petitioner's toxicology data is presented in "RFI Guidance, Interim Final, Section 8- Health and Environmental Assessment," May 1989. A decision on a case-specific level need only reflect that constituents at that level are not hazardous. Such a decision is fully consistent with a later finding that a higher constituent level is also not hazardous. All case-specific levels should be reviewed by Headquarters.

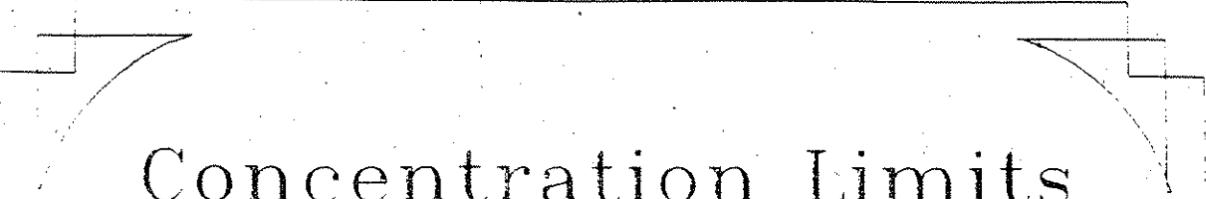
If establishing a case-specific level would delay petition processing and the petitioner does not desire such delay to occur, the surrogate value described below should serve as the "hazardous level" in the "no migration" demonstration.

Surrogate "Hazardous Levels" at the Detection Limit or Practical Quantitation Limit

If a particular hazardous constituent does not have a "health-based level" and a "level of concern" cannot be established due to time constraints or inadequacy of the toxicology data, then a surrogate "hazardous level" may be adopted for the constituent at the lower of (i) the lowest analytical detection limit for that constituent listed in the Third Edition of SW-846 or (ii) the lowest practical quantitation limit given for the constituent in 40 CFR Part 264, Appendix IX. Petitioners are not required to estimate ad hoc detection limits if these published sources do not provide such data, although petitioners do have the option of using such estimates to support their "no migration" demonstration.

Attachment

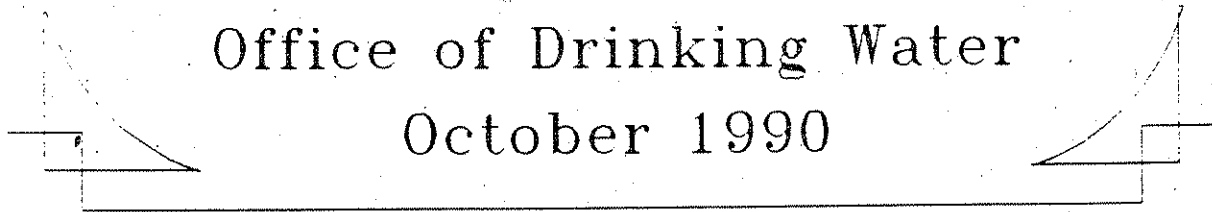




Concentration Limits  
Applicable to  
"No Migration" Petitions  
for  
Injected Hazardous Wastes

No Migration Petition  
Technical Document

U.S. Environmental Protection  
Agency



Office of Drinking Water  
October 1990

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## Concentration Limits Applicable to "No Migration" Petitions

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### FOREWORD

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This technical guidance document addresses the "no migration" petition demonstration under Part 148 Subpart C of the EPA Underground Injection Control Program. It provides petitioners with a list of applicable health-based limits (HBLs) for Appendix VIII hazardous constituents in injected waste subject to a "no migration" demonstration (Appendix C, Table A). Because EPA programs have derived several different HBLs, this guidance document provides an explanation of each (see Section 3 and Appendix A -- Tables B, C, and D) and outlines the decision process for determining the appropriate HBL for each hazardous constituent of concern.

This document is not a comprehensive "no migration" petition resource document. It does not address each step in the petition process. Rather, it provides petitioners with concentration limits at which hazardous constituents in injected fluid that migrates from the injection zone (or point of discharge) are no longer hazardous. Petitioners are urged to contact EPA during the early stages of petition development to determine the level of detail required for a successful demonstration.

## EXECUTIVE SUMMARY

The Resource Conservation and Recovery Act (RCRA) as amended by the Hazardous and Solid Waste Amendments of 1984 (HSWA) imposes significant restrictions on land disposal of hazardous waste. The statute specifically defines land disposal to include, among other things, placement in injection wells. Persons who manage hazardous waste by injection in underground wells must meet the applicable treatment standards promulgated in Part 268 Subpart D. Continued injection of untreated hazardous waste is allowed after the effective date of the regulations if EPA has granted an exemption under Part 148 Subpart C (i.e., a "no migration" exemption), or a case-by-case extension of the effective date. To be granted a "no migration" exemption, the petitioner must demonstrate through modeling that there is no migration of hazardous constituents from the injection zone for as long as the waste remains hazardous. The petitioner may use either of two approaches to make this demonstration. First, flow and transport modeling can be used to show that injected fluids will not migrate vertically out of the injection zone for 10,000 years or laterally within the injection zone to a point of discharge or interface with an underground source of drinking water. Second, geochemical modeling can be used to show that the waste is transformed so that it will become non hazardous at the edge of the injection zone.

A successful "no migration" demonstration using the approaches described above, requires the petitioner to determine the concentration at which hazardous constituents present in the waste are no longer considered hazardous to human health and the

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Concentration Limits Applicable to "No Migration" Petitions

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environment. The Agency states in the preamble to Part 148 (52 FR 28122-28123) that petitioners will use health-based limits (HBLs) which have undergone Agency peer review. Where HBLs are not available, petitioners may submit data which will allow the Agency to derive a HBL. EPA will rely on detection limits when data gaps preclude derivation of HBLs. A hazardous constituent may have more than one HBL, therefore, EPA has developed the following decision process to determine applicable HBLs for the "no migration" demonstration

- 1) Final and proposed maximum contaminant levels (MCLs) are the preferred health-based limit.
- 2) Where MCLs do not exist, the adult oral reference dose (RfD) or risk specific dose (RSD) for the constituent will be used. If both an RfD and RSD exist, the lower of the two will be used.
- 3) If neither an MCL, RfD, nor RSD exists, EPA may use data provided by the petitioner to specify a level of concern.
- 4) When EPA cannot determine a health-based limit expeditiously, the detection limit will be used as a surrogate.

This guidance document provides an explanation of EPA HBLs (Section 3.0) and describes the methodology EPA used for determining which limit should be applied to a specified hazardous constituent (Section 4.0). HBLs applicable to the "no migration" demonstration are listed in Appendix C, Table A.

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TABLE OF CONTENTS

---

1	INTRODUCTION . . . . .	1
1.1	Background . . . . .	1
1.1.1	Treatment Standards . . . . .	2
1.1.2	Effective Dates . . . . .	2
1.1.3	Exemptions and Variances . . . . .	3
2	"NO MIGRATION" PETITION . . . . .	4
2.1	"No migration" Demonstrations . . . . .	4
2.2	Concentration Limits . . . . .	5
3	HEALTH-BASED LIMITS . . . . .	6
3.1	MCLs . . . . .	6
3.2	Reference Doses (RfDs) . . . . .	7
3.3	Risk Specific Doses (RSDs) . . . . .	7
3.4	Detection Limits . . . . .	8
3.5	Ambient Water Quality Criteria . . . . .	9
4	DETERMINATION OF APPROPRIATE CONCENTRATION LIMITS . . . . .	9
5	CONSISTENCY WITH OTHER EPA GUIDANCE . . . . .	13
	APPENDICES . . . . .	14
	APPENDIX A: DERIVATION OF LIMITS . . . . .	14
	APPENDIX B: 40 CFR 148.20 . . . . .	19
	APPENDIX C : TABLES . . . . .	22
	Table A . . . . .	23

---

Concentration Limits Applicable to "No Migration" Petitions

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TABLE B . . . . .	34
Table C . . . . .	36
Table D . . . . .	39
APPENDIX D: REFERENCES . . . . .	41

## 1 INTRODUCTION

### 1.1 Background

A comprehensive framework of laws and regulations has been developed to protect human health and the environment. Among the most important components of this framework are the programs that govern the management of hazardous wastes. Several laws give EPA the authority to regulate different aspects of waste management. The Resource Conservation and Recovery Act of 1976 (RCRA), as amended by the Hazardous and Solid Waste Amendments of 1984 (HSWA), provides the basis for regulating both solid and hazardous waste. Underground injection of hazardous waste is regulated by RCRA and the Underground Injection Control (UIC) program under the Safe Drinking Water Act (SDWA) of 1974, as amended.

One of the primary goals of HSWA is to restrict land disposal of untreated hazardous waste according to a strict schedule specified by Congress. Land disposal includes both surface (such as landfills and impoundments) and subsurface (such as underground injection) disposal. The Agency has already promulgated several land disposal restrictions rulemakings which address disposal of hazardous waste in injection wells.

Some of the major provisions of the land disposal restrictions are summarized below:

#### 1.1.1 Treatment Standards

The Agency develops treatment standards for hazardous waste which are protective of human health and the environment. These standards, based on the performance of the best demonstrated available technology (BDAT), are expressed either as specific technologies or, more generally, as concentration based standards for hazardous constituents. If set as a concentration limit, any treatment technology may be used to reach the standard, but it must be at least as effective as the BDAT. Although dilution as a legitimate part of the treatment process is allowed, dilution as a substitute for adequate treatment of the waste is specifically prohibited.

#### 1.1.2 Effective Dates

Congress required that EPA meet certain deadlines for promulgating treatment standards for specific hazardous waste. Congress mandated a schedule for solvents, dioxins and "California list" wastes (covered under §3004(d), (e), and (f) of RCRA), certain soil and debris, and injected waste. EPA established a schedule for all other hazardous waste covered under §3004(g) of RCRA. EPA may grant an extension beyond the statutory deadline for a total of two years if inadequate nationwide treatment, recovery, or disposal capacity exists. The primary goal is to establish treatment standards for all hazardous waste by May 8, 1990.

Once the Agency promulgates a treatment standard and effective

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## Concentration Limits Applicable to "No Migration" Petitions

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date for a specified waste, the waste may no longer be land disposed unless it meets the treatment standard, or EPA has granted an exemption or variance from the restriction.

### 1.1.3 Exemptions and Variances

There are three primary classes of exemptions or variances from the land disposal restrictions.

The Agency may grant a one year extension of the effective date on a case-by-case basis if a petitioner can demonstrate that treatment, recovery or disposal capacity is not currently available and the petitioner has entered into a binding agreement to create or provide alternative capacity. The extension may be renewed once for a total of two years beyond the effective date. Another variance, the treatability variance, may be granted if a petitioner can demonstrate that the waste stream is significantly different from the waste EPA evaluated when it set the treatment standard and that the promulgated treatment standard cannot be met. In such cases, the Agency will establish an alternative treatment standard applicable to the petitioner's waste and all similar waste.

The third exemption, a "no migration" exemption, may be granted to a disposal facility if the petitioner can demonstrate that the waste will not migrate beyond the disposal unit or injection zone for as long as the wastes remain hazardous.

This technical guidance covers one aspect of the "no migration" exemption for injected wastes: the concentration limit

to be used in determining whether a waste is hazardous at the injection zone boundary. These limits and the "no migration" exemption are discussed further in the following section.

## 2 "NO MIGRATION" PETITION

### 2.1 "No migration" Demonstrations

EPA issued a final rule governing underground injection of hazardous waste into Class I wells on July 26, 1988 (53 FR 82118, et seq.). As described in the previous section, wastes for which a treatment standard and effective date have been promulgated are prohibited from underground injection unless they meet the treatment standard or have been granted an exemption. The "no migration" exemption is described in §148.20 Subpart C of the rule (see Appendix B).

To obtain a "no migration" exemption, the petitioner must demonstrate, among other things, "that, to a reasonable degree of certainty, there will be no migration of hazardous constituents from the injection zone for as long as the waste remains hazardous." This demonstration can be made in either of two ways. First, the petitioner can demonstrate, using flow and transport models, that the injected fluids will not migrate vertically out of the injection zone for 10,000 years, or laterally to a point of discharge or interface with an underground source of drinking water (USDW). Second, the petitioner can use geochemical modeling to demonstrate that the waste is transformed in such a manner that it will become non hazardous at the edge of the injection zone. Both

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Concentration Limits Applicable to "No Migration" Petitions

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methods require health-based concentration limits.

## 2.2 Concentration Limits

In order to demonstrate that the waste is non hazardous, the petitioner must show that "[b]efore the injected fluids migrate out of the injection zone or to a point of discharge or interface with a USDW, the fluid will no longer be hazardous because of attenuation, transformation, or immobilization of hazardous constituents within the injection zone..." [40 CFR 148.20 (a)(1)(ii)]

EPA has interpreted this requirement to mean that the fluid, rather than the individual constituents, leaving the injection zone is not hazardous. This interpretation means that injected fluid leaving the injection zone does not contain Appendix VIII constituents at hazardous levels (40 CFR, Part 261, Appendix VIII). Therefore, in order to demonstrate that the waste is no longer hazardous, the petitioner must be able to show that concentrations of the waste are not harmful to human health or the environment. The preamble to the final rule states that "[t]he emphasis on concentration levels, as opposed to single molecules, is deeply established in EPA's regulations. Ordinarily the term "hazardous constituents" has no regulatory effect unless concentrations are also considered." [53 FR 28122]

The preamble notes that concentration limits to be used in these demonstrations will be health-based limits (HBLs) which have undergone peer review by the Agency. Where no such HBLs exist,

EPA has invited petitioners to submit data which will allow EPA to derive an HBL. In the event that it is impossible to derive an HBL expeditiously, the detection limit for the constituent will be used as a surrogate for the HBL. [53 FR 28123]

Section 4.0 describes the process for determining which concentration limit should be used in a "no migration" petition demonstration.

### 3 HEALTH-BASED LIMITS

There are several classes of HBLs that EPA uses in a variety of environmental programs. The major categories are described below. A more detailed description of how each limit is derived is included in Appendix A.

#### 3.1 MCLs

Maximum Contaminant Levels (MCLs) are set under the authority of the Safe Drinking Water Act (SDWA). MCLs are concentration limits of specific contaminants in drinking water which public water systems may not exceed. MCLs are enforceable standards. In general, the concentration limit is derived from a strictly health-based limit (Maximum Contaminant Level Goals, or MCLGs), taking into account the technological and economic feasibility of removing the contaminant from the public drinking water supply.

Because MCLs are enforceable standards, it is Agency policy that they take precedence over relevant non-promulgated standards

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## Concentration Limits Applicable to "No Migration" Petitions

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and advisories in EPA regulatory programs. Although MCLs reflect technological and economic factors, EPA has determined that MCLs are protective of human health [52 FR 25700-25701].

### 3.2 Reference Doses (RfDs)

Reference doses (RfDs) are concentration limits of specific toxic contaminants (as opposed to carcinogenic) that are "likely to be without appreciable risk of serious deleterious effects during a lifetime" of daily exposure. Unlike the RSDs described below, RfDs assume that there is some (finite) exposure to the constituent which can be tolerated without causing a toxic effect.

The calculation of an RfD takes into account the reliability of health effects data available on the toxicant by using uncertainty factors, and is protective of sensitive populations. The calculation also makes certain assumptions about exposure scenarios.

RfDs are non-enforceable limits. Many of the RfDs have been verified by the EPA RfD Workgroup, and are considered to be reliable health-based limits after MCLs for non-carcinogens. RfDs are revised when new and better data become available.

### 3.3 Risk Specific Doses (RSDs)

To derive risk specific doses (RSDs) for a carcinogen, EPA estimates carcinogenic potency (yielding a "dose-response" curve), linking human lifetime exposure to the constituent with excess

cancer risk. Therefore, the constituent RSD is the exposure concentration (dose) associated with a specified risk level (response).

It is assumed that there is no exposure level for carcinogens that does not have some risk of causing a carcinogenic response. The risk level (i.e.,  $10^{-6}$ , or 1 excess cancer case in 1,000,000) for a particular constituent reflects the weight of the evidence that the constituent is carcinogenic. (Risk levels and RSDs are described further in Appendix A).

Similar to RfDs, RSDs are non-enforceable health-based limits and, in general, play the same role for carcinogenic constituents that RfDs play for toxic constituents. The Agency also revises RSDs when new and better data become available.

### 3.4 Detection Limits

Detection limits are not health-based limits. Rather, they reflect our technological capability to detect a constituent using certain techniques.

Some analytical programs require modeling to demonstrate that concentration limits below the detection limit are met. Other programs use the detection limit as a default value. Detection limits change as technology improves.

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## Concentration Limits Applicable to "No Migration" Petitions

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### 3.5 Ambient Water Quality Criteria

National Ambient Water Quality Criteria (AWQC) apply to surface water and, therefore, are inappropriate for groundwater programs. AWQC are non-enforceable guidelines which many States have used in establishing enforceable standards. They are health-based limits analogous to MCLGs. Their derivation assumes human exposure via two routes --ingestion of water and fish, and consumption of fish only.

## 4 DETERMINATION OF APPROPRIATE CONCENTRATION LIMITS

Figure 1 illustrates the decision process for determining the applicable HBL to use in a "no migration" demonstration. The appropriate concentration limits are listed in Appendix C, Table A of this document. These numbers are subject to change, therefore, petitioners are encouraged to access the "Integrated Risk Information System (IRIS)" to obtain up-to-date information on health-based levels.

Step 1: Determine whether there is a proposed or final MCL for the waste. If so, the MCL (or proposed MCL) is the limit that should be used. MCLs and proposed MCLs for Appendix VIII constituents are listed in Appendix C, Table B.

Rationale: The Agency has promulgated MCLs and Ambient Water Quality Criteria (AWQC). As discussed earlier, the AWQC are based on consumption of fish alone or consumption of fish and surface water. There are no AWQC for consumption of water alone.

# Underground Injection Control Program Guidance No. 66

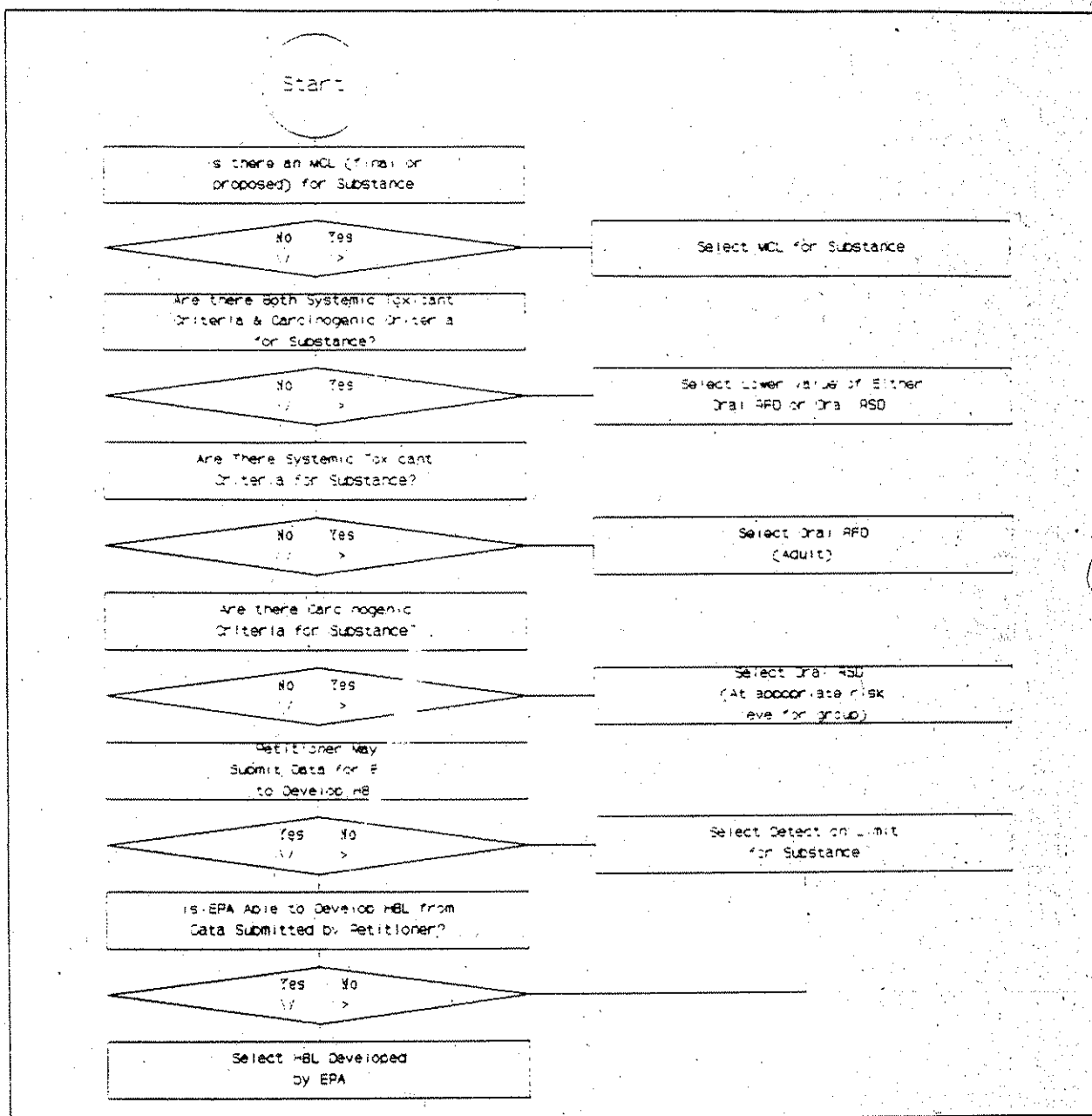


Figure 1 - Decision process for determining the applicable HBL to use in a "no migration" petition.

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Concentration Limits Applicable to "No Migration" Petitions

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Therefore, the AWQC do not apply to exposure scenarios with ground water considerations such as migration of hazardous constituents from an injection well to an aquifer. However, the Superfund Public Health Evaluation Manual, (U.S. EPA, October 1986) suggests that calculations can be made to derive an adjusted water quality criterion for drinking water ingestion only. For purposes of this guidance this approach has been rejected because additional calculations necessary to modify the criterion are not defensible given the availability of a uniformly derived drinking water standard (i.e., an MCL). The Agency believes, therefore, that a less stringent standard contradicts the strict "no migration" standard set by Congress.

Step 2: If a proposed or final MCL has not been promulgated, determine whether there is an RfD or RSD for the waste. If so, the adult oral RfD or RSD should be used. If there is both an RfD and an RSD (e.g., acetonitrile and chloroform), the lower limit should be used.

RfDs and RSDs for Appendix VIII constituents are listed in Appendix C, Table C and D, respectively.

Rationale: The adult exposure assumptions for drinking water assume water intake of 2 liters/day for a 70 kg adult over a 70-year lifetime. These assumptions take into account exposure from drinking water over a long time period. They represent standard EPA assumptions for a reasonable, worst-case scenario. For Group A and Group B carcinogens, the risk level should be  $10^{-6}$ ; for Group C carcinogens,  $10^{-5}$ .

The Agency also considered application of "relative source contribution" (RSC) to RfDs and RSDs because unlike MCLs, these standards take into account all ingestion sources (MCLs take into account exposure from drinking water only). However, the Agency believes that consistency with MCLs is not a realistic goal because MCLs factor in additional elements such as cost and technological feasibility. Because the "no migration" demonstration excludes certain waste from regulation, petition requirements should be sufficiently stringent to account for any additional uncertainty. Therefore, the Agency recommends use of unapportioned RfDs and RSDs.

[Note: The majority of EPA guidance documents which address exposure to ground water employ the same preference for MCLs followed by RfDs and RSDs as the applicable health-based limits.]

Step 3: Where there is no MCL, RfD or RSD for the waste, EPA will use data provided by the petitioner to develop a level of concern [see 53 FR 28123].

Rationale: Health-based limits do not exist for all hazardous constituents in Appendix VIII. However, the Agency recognizes that data exists which have not undergone formal Agency review. The Agency will allow petitioners to submit such data for consideration, provided that such data meet EPA testing guidelines (see 50 FR 39252).

Step 4: Where sufficient data do not exist for EPA to establish a level of concern, the detection limit for the hazardous constituent will act as the surrogate for an HBL. The methodology

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## Concentration Limits Applicable to "No Migration" Petitions

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for determining the detection limit is described in EPA Publication No. SW-846 (Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Third Edition).

When considering the concentration limit of a particular constituent at the injection zone boundary, EPA may consider additive effects of additional constituents. Guidelines for evaluating additive affects of multiple contaminants are available in the Guidelines for the Health Risk Assessment of Chemical Mixtures, (51 FR 34014, September 24, 1986).

Rationale: EPA has used detection limits where HBLs are unavailable in its clean closure, corrective action, and delisting programs.

### 5. CONSISTENCY WITH OTHER EPA GUIDANCE

The approach described in Section 4 is generally consistent with the following existing EPA guidance documents: RCRA Facility Investigations (RFI) Guidance, (U.S. EPA, Draft Final, March, 1988), and the Surface Impoundment Clean Closure Guidance, (U.S. EPA, Draft Final, October, 1987). [The Agency is in the process of revising the surface impoundment guidance document to achieve greater consistency with other waste management programs.] The Agency has also coordinated development of this guidance document with relevant EPA regulations and guidance currently under development (e.g., "no migration" petition guidance for disposal units other than injection wells, De minimis program, and the Toxicity Characteristic program).

APPENDICES

APPENDIX A: DERIVATION OF LIMITS

These definitions are used in the following description of how MCLs, RfDs, and RSDs are derived:

1. BW = Body weight (assume adult = 70 kg)
2. DWEL = Drinking water equivalent level
3. I = Intake (assume 2 liters of water/day for adult)
4. LOAEL = Lowest observed adverse effect level
5. MF = Modifying factor (reflects professional judgment of the entire data base of the chemical)
6. NOAEL = No observed adverse effect level
7.  $q_1^*$  = the carcinogen slope factor (CSF) in  $(\text{mg/kg/day})^{-1}$
8. R = specified risk level (e.g.,  $10^{-6}$ )
9. UF = Uncertainty factor (additional modifying factor when using LOAEL instead of NOAEL -- reflects various types of data sets used to estimate RfDs)

A. Risk Levels for Carcinogens

EPA has issued guidelines [51 FR 33992] that create groups of carcinogens based on the weight of evidence used in determining the substances' carcinogenicity. HBLs, such as MCLGs and RSDs, make use of these groupings.

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Concentration Limits Applicable to "No Migration" Petitions

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Group A (human carcinogens) include substances for which epidemiologic evidence is sufficient to show a causal connection between exposure to the constituent and cancer.

Group B are probable human carcinogens. Group B1 carcinogens include those for which there is limited epidemiologic evidence, but animal evidence is sufficient. Group B2 carcinogens have sufficient animal evidence, but epidemiologic evidence is inadequate or lacking.

Group C (possible human carcinogens) lack human data and show limited evidence of carcinogenicity in animals. Group D (not classifiable) carcinogens include those for which evidence of human and animal carcinogenicity is inadequate or lacking.

Group E (non-carcinogens) includes substances for which adequate epidemiologic and animal studies, or at least two animal studies, show no evidence of carcinogenicity.

#### B. MCLs

The first step of determining an MCL is to derive the maximum contaminant level goal (MCLG, formerly known as recommended maximum contaminant levels, or RMCLs). MCLGs are strictly health-based. They are set at a level where no adverse health effect is known to occur and include a margin of safety to protect especially sensitive populations.

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Underground Injection Control Program Guidance No. 66

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In calculating an MCLG, it is assumed that a 70 kg adult consumes 2 liters of water a day over a 70-year lifetime. Other sources of the contaminant (such as air and food) are considered and deducted from the calculation. Therefore, the MCLG reflects lifetime exposure from drinking water only.

MCLs are set as close to the MCLG substance as feasible. According the statute, "[f]easible means with the use of the best technology, treatment techniques and other means, which the Administrator [of EPA] finds, after examination for efficacy under field conditions and not solely under laboratory conditions, are available (taking costs into consideration)." Because the MCL takes non-health factors into consideration, the MCLG is always less than or equal to the MCL:

MCLGs

(Non-Carcinogens):

$$1. \text{ DWEL} = (\text{RfD}) \times \frac{(\text{BW})}{(\text{I})}$$

$$2. \text{ MCLG} = \text{DWEL} - \text{RSC}(\text{food}) - \text{RSC}(\text{air})$$

or, if data for air and food RSCs are unavailable:

$$\text{MCLG} = \text{DWEL} \times \text{RSC}(\text{drinking water})$$

[Note: the MCLG is the same as the lifetime Health Advisory]

(Carcinogens):

1. Group A and B carcinogens: MCLG = zero.

2. Group C carcinogens: MCLGs = DWEL/UF.

3. Group D and E carcinogens: MCLGs = RfD.

C. Oral Reference Dose (RfD)

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## Concentration Limits Applicable to "No Migration" Petitions

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RfDs are derived using the highest test dose associated with a no-observed-effect or no-observed-adverse-effect-level (NOAEL). Reliability of the data used is reflected in uncertainty factors. For example, when results of human exposure of appropriate durations are used to determine the NOAEL, an uncertainty factor of 10 is used. If human data are unavailable, and the data used are based on extrapolation from long-term animal studies, the uncertainty factor is 100. The uncertainty factor would be 1000 if human data and long-term animal data were unavailable, and the data used for the NOAEL were extrapolated from less than chronic animal exposure. If no NOAEL is available and a lowest-observed-adverse-effect-level (LOAEL) must be used, an additional modifying factor of 1-10 is used.

$$1. \text{ RfD} = \frac{(\text{NOAEL or LOAEL})}{(\text{UF} \times \text{MF})}$$

$$2. \text{ Oral Adult RfD} = \frac{(\text{RfD}) \times (\text{BW})}{(\text{I})}$$

[Note: the systemic toxicant criteria for ground water cited in RFI guidance are the same as the Oral Adult RfD]

While EPA prefers to use verified RfDs, unverified RfDs can be used as the best surrogate HBL until the verification procedure is complete.

D. Oral Risk Specific Dose (RSD)

As described above in Section 3.3, a risk level must be specified in order to determine the RSD for a given carcinogen. In the following equation, (R) refers to the risk factor associated with the constituent. For Group A and B carcinogens, the risk factor is set at  $10^{-6}$ . For Group C carcinogens, the risk factor is  $10^{-5}$ . For those Group C carcinogens where data to perform a quantitative risk assessment are inadequate, an additional uncertainty factor of 10 is used.

$$1. \text{ RSD} = \frac{(R)}{(q_1^*)}$$

$$2. \text{ Oral Adult RSD} = (\text{RSD}) \times \frac{(\text{BW})}{(\text{I})}$$

[Note: the "carcinogenic criteria" for ground water cited in the RFI guidance are the same as the Oral Adult RSD]

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Concentration Limits Applicable to "No Migration" Petitions

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APPENDIX B: 40 CFR 148.20

Subpart C -- Petition Standards and Procedures

§ 148.20 Petitions to allow injection of a waste prohibited under Subpart B.

(a) Any person seeking an exemption from a prohibition under Subpart B of this part for the injection of a restricted hazardous waste into an injection well or wells shall submit a petition to the Director demonstrating that, to a reasonable degree of certainty, there will be no migration of hazardous constituents from the injection zone for as long as the waste remains hazardous. This demonstration requires a showing that:

(1) The hydrogeological and geochemical conditions at the sites and the physiochemical nature of the waste stream(s) are such that reliable predictions can be made that:

(i) Fluid movement conditions are such that the injected fluids will not migrate within 10,000 years:

(A) Vertically upward out of the injection zone; or

(B) Laterally within the injection zone to a point of discharge or interface with an Underground Source of Drinking Water (USDW) as defined in 40 CFR Part I 146; or

(ii) Before the injected fluids migrate out of the injection zone or to a point of discharge or interface with USDW, the fluid will no longer be hazardous because of attenuation, transformation, or immobilization of hazardous constituents within the injection zone by hydrolysis, chemical interactions or other means; and

(2) For each well the petition has:

(i) Demonstrated that the injection well's area of review complies with the substantive requirements of § 146.63;

(ii) Located, identified, and ascertained the condition of all wells within the injection well's area of review (as specified in § 146.63) that penetrate the injection zone or the confining

zone by use of a protocol acceptable to the Director that meets the substantive requirements of § 146.63;

(iii) Submitted a corrective action plan that meets the substantive requirements of § 146.64, the implementation of which shall become a condition of petition approval; and

(iv) Submitted the results of pressure and radioactive tracer tests performed within one year prior to submission of the petition demonstrating the mechanical integrity of the well's long string casing, injection tube, annular seal, and bottom hole cement. In cases where the petition has not been approved or denied within one year after the initial demonstration of mechanical integrity, the Director may require the owner or operator to perform the test again and submit the results of the new tests.

Note. -- The requirements of § 148.20(a)(2) need not be incorporated in a permit at the time of petition approval.

(b) A demonstration under § 148.20(a)(1)(i) shall identify the strata within the injection zone which will confine fluid movement above the injection interval and include a showing that this strata is free of known transmissive faults or fractures and that there is a confining zone above the injection zone.

(c) A demonstration under § 148.20(a)(1)(ii) shall identify the strata within the injection zone where waste transformation will be accomplished and include a showing that this strata is free of known transmissive faults or fractures and that there is a confining zone above the injection zone.

(d) A demonstration may include a showing that:

(1) Treatment methods, the implementation of which shall become a condition of petition approval, will be utilized that reduce the toxicity or mobility of the wastes; or

(2) A monitoring plan, the implementation of which shall become a condition of petition approval, will be utilized to enhance confidence in one or more aspects of the demonstration.

(e) Any person who has been granted an exemption pursuant to this section may submit a petition for reissuance of the exemption

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Concentration Limits Applicable to "No Migration" Petitions

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to include an additional restricted waste or wastes or to modify any conditions placed on the exemption by the Director. The Director shall reissue the petition if the petitioner complies with the requirement of paragraphs (a), (b), and (c) of this section.

(f) Any person who has been granted an exemption pursuant to this section may submit a petition to modify an exemption to include an additional (hazardous) waste or wastes. The Director may grant the modification if he determines, to a reasonable degree of certainty, that the additional waste or wastes will behave hydraulically and chemically in a manner similar to previously included wastes and that it will not interfere with the containment capability of the injection zone.

APPENDIX C : TABLES

Table A : Applicable Health-Based Limits for "No Migration  
Petitions

Table B : Maximum Contaminant Levels (MCLs)

Table C : Health-Based Criteria for Systemic Toxicants

Table D : Health-Based Criteria for Carcinogens

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Concentration Limits Applicable to "No Migration" Petitions

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Table A

Applicable Health-Based Limits For "No Migration" Petition

Constituent	Health-Based Limits <sup>1</sup> (mg/kg)
Acetonitrile	2E - 1**
Acetophenone	4E + 0**
2-Acetylaminofluorene	
Acetyl chloride	
1-Acetyl-2-thiourea	
Acrolein	
Acrylamide	9E - 6***
Acrylonitrile	7E - 5***
Aflatoxins	
Aldicarb	1E - 2*
Aldrin	2E - 6***
Allyl alcohol	2E - 1**
Aluminum phosphide	1E - 2**
4-Aminobiphenyl	
5-(aminomethyl)-3-isoxazolol	
4-Aminopyridine	
Amitrole	
Ammonium vanadate	
Aniline	1E - 2***
Antimony	1E - 2**
Antimony compounds, N.O.S. <sup>2</sup>	1E - 2
**	
Aramite	
Arsenic	5E - 2*
Arsenic compounds, N.O.S. <sup>2</sup>	5E - 2*
Arsenic acid	
Arsenic pentoxide	
Arsenic trioxide	
Auramine	
Azaserine	
Barium	1E + 0*
Barium compounds, N.O.S. <sup>2</sup>	1E + 0*
Barium cyanide	2E + 0**
Benz[c]acridine	
Benz[a]anthracene	1E - 5***

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Underground Injection Control Program Guidance No. 66

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Benzal chloride	
Benzene	5E - 3*
Benzene arsonic acid	
Benzidine	7E - 2**
Benzo[b]fluoranthene	
Benzo[j]fluoranthene	
Benzo[a]pyrene	3E - 6***
p-Benzoquinone	
Benzotrichloride	
Benzyl chloride	
Beryllium	7E - 6***
Beryllium compounds, N.O.S. <sup>2</sup>	7E - 6***
Bromoacetone	
Bromoform	7E - 1**
4-Bromophenyl phenyl ether	
Brucine	
Butyl benzyl phthalate	

Cacodylic acid	
Cadmium	1E - 2*
Cadmium compounds, N.O.S. <sup>2</sup>	1E - 2*
Calcium chromate	
Calcium cyanide	1E + 0**
Carbon disulfide	4E + 0**
Carbon oxyfluoride	
Carbon tetrachloride	5E - 3*
Chloral	
Chlorambucil	
Chlordane	2E - 3*
Chlordane (alpha and gamma isomers)	
Chlorinated benzenes, N.O.S. <sup>2</sup>	
Chlorinated ethane, N.O.S. <sup>2</sup>	
Chlorinated fluorocarbons, N.O.S. <sup>2</sup>	
Chlorinated naphthalene, N.O.S. <sup>2</sup>	
Chlorinated phenol, N.O.S. <sup>2</sup>	
Chlornaphazin	
Chloroacetaldehyde	
Chloroalkyl ethers, N.O.S. <sup>2</sup>	
p-Chloroaniline	
Chlorobenzene	1E + 1*
Chlorobenzilate	
p-Chloro-m-cresol	
2-Chloroethyl vinyl ether	

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Concentration Limits Applicable to "No Migration" Petitions

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Chloroform	6E - 3***
Chloromethyl methyl ether	4E - 6***
beta-Chloronaphthalene	
o-Chlorophenol	
1-(o-Chlorophenyl)thiourea	
Chloroprene	
3-Chloropropionitrile	
Chromium	1E - 2*
Chromium compounds, N.O.S. <sup>2</sup>	1E - 2*
Chromium III	4E + 1**
Chromium (hexavalent)	5E - 2*
Chrysene	
Citrus red No. 2	
Coal tar creosote	
Copper cyanide	2E - 0**
Creosote	
Cresol (Cresylic acid)	2E + 0**
Crotonaldehyde	4E - 1**
Cyanides (soluble salts and complexes), N.O.S. <sup>2</sup>	7E - 1**
Cyanogen	1E + 0**
Cyanogen bromide	
Cyanogen chloride	
Cycasin	
2-Cyclohexyl-4,6-dinitrophenol	
Cyclophosphamide	
2,4-D	
2,4-D, salts & esters	
Daunomycin	
DDD	1E - 4***
DDE	1E - 4***
DDT	1E - 4***
Diallate	
Dibenz[a,h]acridine	
Dibenz[a,j]acridine	
Dibenz[a,h]anthracene	7E - 7***
7H-Dibenzo[c,g]carbazole	
Dibenzo[a,e]pyrene	
Dibenzo[a,h]pyrene	
Dibenzo[a,i]pyrene	
1,2-Dibromo-3-chloropropane	2E - 4*
Dibutyl phthalate	
1,2-dichlorobenzene (o-Dichlorobenzene)	6E -

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Underground Injection Control Program Guidance No. 66

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1*	
1,3-dichlorobenzene (m-Dichlorobenzene)	6E - 1*
1,4-dichlorobenzene (p-Dichlorobenzene)	7.5E - 2*
Dichlorobenzene, N.O.S. <sup>2</sup>	
3,3'-Dichlorobenzidine	
1,4-Dichloro-2-butene	
Dichlorodifluoromethane	7E + 0**
Dichloroethylene, N.O.S. <sup>2</sup>	
1,1-Dichloroethylene	7E - 3*
1,2-Dichloroethylene	
Dichloroethyl ether	
Dichloroisopropyl ether	
Dichloromethoxy ethane	
Dichloromethylether	
2,4-Dichlorophenol	1E - 1**
2,6-Dichlorophenol	
Dichlorophenylarsine	
Dichloropropane, N.O.S. <sup>2</sup>	
Dichloropropanol, N.O.S. <sup>2</sup>	
Dichloropropene, N.O.S. <sup>2</sup>	
1,3-Dichloropropene	2E - 4 ***
Dieldrin	2E - 6***
1,2:3,4-Diepoxybutane	
Diethylarsine	
1,4-Diethyleneoxide (1,4-dioxane)	7E - 3***
Diethylhexyl phthalate	
N,N'-Diethylhydrazine	
O,O-Diethyl S-methyl dithiophosphate	
Diethyl-p-nitrophenyl phosphate	
Diethyl phthalate	3E + 1**
O,O-Diethyl O-pyrazinyl phosphorothioate	
Diethylstilbesterol	7E - 8***
Dihydrosafrole	
Diisopropylfluorophosphate (DFP)	
Dimethoate	7E - 1**
3,3'-Dimethoxybenzidine	
p-Dimethylaminoazobenzene	
7,12-Dimethylbenz[a]anthracene	
3,3'-Dimethylbenzidine	
Dimethylcarbamoyl chloride	
1,1-Dimethylhydrazine	
1,2-Dimethylhydrazine	
alpha,alpha-Dimethylphenethylamine	
2,4-Dimethylphenol	

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Concentration Limits Applicable to "No Migration" Petitions

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Dimethyl phthalate	
Dimethyl sulfate	
Dinitrobenzene, N.O.S. <sup>2</sup>	
4,6-Dinitro-o-cresol	
4,6-Dinitro-o-cresol salts	
2,4-Dinitrophenol	
2,4-Dinitrotoluene	7E - 2**
2,6-Dinitrotoluene	1E - 4***
Dinoseb	4E - 2**
Di-n-octyl phthalate	
Diphenylamine	1E + 0**
1,2-Diphenylhydrazine	4E - 5***
Di-n-propylnitrosamine	
Disulfoton	1E - 3**
Dithiobiuret	
Endosulfan	2E - 3**
Endothall	7E - 1**
Endrin	2E - 4*
Endrin metabolites	
Epichlorohydrin	4E - 3***
Epinephrine	
Ethyl carbamate (urethane)	
Ethyl cyanide	
Ethylenebisdithiocarbamic acid	
Ethylenebisdithiocarbamic acid, salts & esters	
Ethylene dibromide	5E - 5 *
Ethylene dichloride	
Ethylene glycol monoethyl ether	
Ethyleneimine	
Ethylene oxide	1E - 4***
Ethylenethiourea	
Ethylidene dichloride	
Ethyl methacrylate	
Ethyl methanesulfonate	
Famphur	
Fluoranthene	
Fluorine	4E + 0*
Fluoroacetamide	
Fluoroacetic acid, sodium salt	
Formaldehyde	

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Underground Injection Control Program Guidance No. 66

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Formic acid

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Glycidylaldehyde

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Halomethanes, N.O.S.<sup>2</sup>

Heptachlor 4E - 4\*

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Heptachlor epoxide 2E - 4\*

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Heptachlor epoxide (alpha, beta, & gamma isomers)

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Hexachlorobenzene 2E - 5\*\*\*

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Hexachlorobutadiene 5E - 3\*\*\*

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Hexachlorocyclopentadiene 2E - 1\*\*

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Hexachlorodibenzo-p-dioxins 6E - 9\*\*\*

---

Hexachlorodibenzofurans

---

Hexachloroethane 3E - 2\*\*\*

---

Hexachlorophene

---

Hexachloropropene

---

Hexaethyl tetraphosphate

---

Hydrazine 1E - 5\*\*\*

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Hydrogen cyanide 7E - 1\*\*

---

Hydrogen fluoride

---

Hydrogen sulfide 1E - 1\*\*

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Indeno[1,2,3-cd]pyrene

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Iron dextran

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Isobutyl alcohol 1E + 1\*\*

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Isodrin

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Isosafrole

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Kepone

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Lasiocarpine

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Lead 5E - 2\*

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Lead compounds, N.O.S.<sup>2</sup> 5E - 2\*

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Lead acetate

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Lead phosphate

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Lead subacetate

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Lindane 4E - 3\*

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Concentration Limits Applicable to "No Migration" Petitions

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Maleic anhydride	
Maleic hydrazide	2E + 1**
Malononitrile	
Melphalan	
Mercury	2E - 3*
Mercury compounds, N.O.S. <sup>2</sup>	2E - 3*
Mercury fulminate	
Methacrylonitrile	4E - 3**
Methapyrilene	
Methomyl	1E + 0**
Methoxychlor	1E - 1*
Methyl bromide (bromomethane)	1E - 2**
Methyl chloride (dichloromethane)	5E - 3***
Methyl chlorocarbonate	
Methyl chloroform (1,1,1-trichloroethane)	2E - 1*
3-Methylcholanthrene	4E - 6***
4,4'-Methylenebis(2-chloroaniline)	2E - 4***
Methylene bromide	
Methylene chloride	
Methyl ethyl ketone (MEK)	2E + 0**
Methyl ethyl ketone peroxide	
Methyl hydrazine	
Methyl iodide	
Methyl isocyanate	
2-Methylactonitrile	
Methyl methacrylate	
Methyl methanesulfonate	
Methyl parathion	1E - 2**
Methylthiouracil	
Mitomycin C	
MNNG	
Mustard gas	
Naphthalene	
1,4-Naphthoquinone	
alpha-Naphthylamine	
beta-Naphthylamine	
alpha-Naphthylthiourea	
Nickel	7E - 1**
Nickel compounds, N.O.S. <sup>2</sup>	7E - 1**
Nickel carbonyl	
Nickel cyanide	
Nicotine	

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Underground Injection Control Program Guidance No. 66

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Nicotine salts	
Nitric oxide	4E + 0**
p-Nitroaniline	
Nitrobenzene	2E - 2**
Nitrogen dioxide	4E + 1**
Nitrogen mustard	
Nitrogen mustard, hydrochloride salt	
Nitrogen mustard N-oxide	
Nitrogen mustard, N-oxide, hydrochloride salt	
Nitroglycerin	
p-Nitrophenol	
2-Nitropropane	4E - 6***
Nitrosamines N.O.S. <sup>2</sup>	
N-Nitrosodi-n-butylamine	1E - 5***
N-Nitrosodiethanolamine	
N-Nitrosodiethylamine	
N-Nitrosodimethylamine (Dimethylnitrosamine)	7E - 7***
N-Nitroso-N-ethylurea	
N-Nitrosomethylethylamine	2E - 6***
N-Nitroso-N-methylurea	1E - 7***
N-Nitroso-N-methylurethane	
N-Nitrosomethylvinylamine	
N-Nitrosomorpholine	
N-Nitrosornicotine	
N-Nitrosopiperidine	
N-Nitrosopyrrolidine	2E - 5***
N-Nitrososarcosine	
5-Nitro-o-toluidine	
Octamethylpyrophosphoramide	7E - 2**
Osmium tetroxide	
Paraldehyde	
Parathion	1E - 2**
Pentachlorobenzene	3E - 2**
Pentachlorodibenzo-p-dioxins	
Pentachlorodibenzofurans	
Pentachloroethane	
Pentachloronitrobenzene (PCNB)	1E - 3***
Pentachlorophenol	2E - 2*
Phenacetin	
Phenol	1E + 0**

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Concentration Limits Applicable to "No Migration" Petitions

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Phenylenediamine acetate	3E - 3**
Phenylthiourea	
Phosgene	
Phosphine	1E - 2**
Phorate	
Phthalic acid esters, N.O.S. <sup>2</sup>	
Phthalic anhydride	
2-Picoline	
Polychlorinated biphenyls, N.O.S. <sup>2</sup>	5E - 4*
Potassium cyanide	2E + 0**
Potassium silver cyanide	7E + 0**
Pronamide (kerb)	3E + 0**
1,3-Propane sultone	
n-Propylamine	
Propargyl alcohol	
Propylene dichloride	
1,2-Propylenimine	
Propylthiouracil	
Pyridine	4E - 2**
Reserpine	3E - 6***
Resorcinol	
Saccharin	
Saccharin salts	
Safrole	
Selenium	1E - 2*
Selenium compounds, N.O.S. <sup>2</sup>	1E - 2 *
Selenium dioxide	
Selenium sulfide	
Selenourea	2E - 1**
Silver	5E - 2*
Silver compounds, N.O.S. <sup>2</sup>	5E - 2 *
Silver cyanide	4E + 0**
Silvex (2,4,5-TP)	3E - 1**
Sodium cyanide	1E + 0**
Streptozotocin	
Strontium sulfide	
Strychnine	1E - 2**
Strychnine salts	1E - 2**
TCDD	

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Underground Injection Control Program Guidance No. 66

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1,2,4,5-Tetrachlorobenzene	1E - 2**
Tetrachlorodibenzo-p-dioxins	
Tetrachlorodibenzofurans	
Tetrachloroethane, N.O.S. <sup>2</sup>	
1,1,1,2-Tetrachloroethane	
1,1,2,2-Tetrachloroethane	2E - 3***
Tetrachloroethylene (perchloroethylene)	5E - 3*
2,3,4,6-Tetrachlorophenol	1E + 0**
Tetraethyldithiopyrophosphate	
Tetraethyl lead	4E - 6**
Tetraethyl pyrophosphate	
Tetranitromethane	
Thallium	
Thallium compounds, N.O.S. <sup>2</sup>	
Thallic oxide	1E - 2**
Thallium(I) acetate	2E - 2**
Thallium(I) carbonate	1E - 2**
Thallium(I) chloride	1E - 2**
Thallium(I) nitrate	2E - 2**
Thallium selenite	2E - 2**
Thallium(I) sulfate	1E - 2**
Thioacetamide	
Thiofanox	
Thiomethanol	
Thiophenol	
Thiosemicarbazide	
Thiourea	5E - 5***
Thiram	2E - 1**
Toluene	2E + 0*
Toluenediamine	
Toluene-2,4-diamine	
Toluene-2,6-diamine	
Toluene-3,4-diamine	
Toluene diisocyanate	
o-Toluidine	
o-Toluidine hydrochloride	
p-Toluidine	
Toxaphene	5E - 3*
1,2,4-Trichlorobenzene	7E - 1**
1,1,2-Trichloroethane	6E - 3***
Trichloroethylene	5E - 3*
Trichloromethanethiol	
Trichloromonofluoromethane	1E + 1**
2,4,5-Trichlorophenol	4E + 0**

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Concentration Limits Applicable to "No Migration" Petitions

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2,4,6-Trichlorophenol	2E - 3***
2,4,5-T	1E - 2*
Trichloropropane, N.O.S. <sup>2</sup>	
1,2,3-Trichloropropane	4E - 2**
O,O,O-Triethyl phosphorothioate	
1,3,5-Trinitrobenzene	
Tris(1-aziridinyl)phosphine sulfide	
Tris(2,3-dibromopropyl) phosphate	
Trypan blue	

Uracil mustard

Vanadium pentoxide	7E - 1**
Vinyl chloride	2E - 3*

Warfarin 1E - 2\*\*

Warfarin salts, when present at concentrations less than 0.3%

Warfarin salts, when present at concentrations greater than 0.3%

Xylene 10E + 0\*

Zinc cyanide	2E + 0**
Zinc phosphide	1E - 2**

<sup>1</sup> These criteria are subject to change. Petitioners should consult "Integrated Risk Information System (IRIS)."

<sup>2</sup> The abbreviation N.O.S. (not otherwise specified) signifies those members of the general class not specifically listed by name in this appendix.

\*MCL or proposed MCL (Maximum Contaminant Levels)  
\*\*RfD (Reference Dose)  
\*\*\*RSD (Risk Specific Dose)

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Underground Injection Control Program Guidance No. 66

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TABLE B  
MAXIMUM CONTAMINANT LEVELS (MCLs)

<u>Constituent</u>	<u>MCL (mg/l)</u>
Acrylamide	treatment technology*
Aldicarb	0.01*
Arsenic	0.05
Barium	1.0
Benzene	0.005
Cadmium	0.01
Carbon tetrachloride	0.005
Chlorobenzene	0.10
Chlordane	0.002*
Chromium (Total)	0.10
Chromium (Hexavalent)	0.05
2, 4-Dichlorophenoxy acetic acid	0.10
1, 4-Dichlorobenzene	0.075
1, 2-Dichlorobenzene	0.60*
1, 3-Dichlorobenzene	0.60*
1, 2-Dichloroethane	0.005
1, 1-Dichloroethylene	0.007
1, 2-Dibromo-3-chloropropane	0.0002*
Endrin	0.0002
Epichlorohydrin	treatment technology*
Ethylbenzene	0.70*
Ethylene dibromide	0.00005*
Flouride	4.0
Heptachlor	0.0004*
Heptachlor epoxide	0.0002*
Lead	0.05
Lindane	0.004
Mercury	0.002
Methoxychlor	0.10
Nitrate	10.0
Pentachlorophenol	0.20*
PCBs	0.0005*
Selenium	0.01
Silver	0.05
Toxaphene	0.005
Tetrachloroethylene	0.005*

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Concentration Limits Applicable to "No Migration" Petitions

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Toluene	2.0*
1, 1, 1-Trichloroethane	0.2
Trichloroethylene	0.005
2, 4, 5-Trichlorophenoxy acetic acid	0.01
Vinyl chloride	0.002
Xylene	10.0*

\* proposed MCL

Table C  
Health-Based Criteria for Systemic Toxicants

Constituent	RfD (mg/kg/day)
Acetone	4E + 0
Acetonitrile	2E - 1
Acetophenone	4E + 0
Aldicarb	4E - 2
Aldrin	1E - 3
Allyl alcohol	2E - 1
Aluminum phosphide	1E - 2
Antimony	1E - 2
Barium	1E - 0
Barium cyanide	2E + 0
Benzidine	7E - 2
Beryllium	4E - 1
Bis(2-ethylhexyl) phthalate	2E + 0
Bromodichloromethane	7E - 1
Bromoform	7E - 1
Bromomethane	1E - 2
Calcium cyanide	1E + 0
Carbon disulfide	4E + 0
Carbon tetrachloride	See MCL
Chlordane	2E - 3
Chlorine cyanide	2E + 0
Chlorobenzene	1E + 0
1-Chloro-2, 3 epoxypropane (Epichlorohydrin)	7E - 2
Chloroform	4E - 1
Chromium (III)	4E + 1
Chromium (VI)	See MCL
Copper cyanide	2E - 1
Cresols	2E + 0
Crotonaldehyde	4E - 1
Cyanide	7E - 1
Cyanogen	1E + 0
2, 4-D	See MCL
DDT	2E - 2
Di-n-butylphthalate	4E - 3
Dichlorodifluoromethane	7E + 0
1, 1-Dichloroethylene	See MCL

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Concentration Limits Applicable to "No Migration" Petitions

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Dichloromethane (Methylene chloride)	2E + 0
2, 4-Dichlorophenol	1E - 1
1, 3-Dichloropropene	1E - 2
Dieldrin	2E - 3
Diethylphthalate	3E + 1
Dimethoate	7E - 1
2, 4-Dinitrophenol	7E - 2
Dinoseb	4E - 2
Diphenylamine	1E + 0
Disulfoton	1E - 3
Endosulfan	2E - 3
Endothal	7E - 1
Endrin	See MCL
Ethylbenzene	4E + 0
Heptachlor	2E - 2
Heptachlor epoxide	4E - 4
Hexachlorobutadiene	7E - 2
Hexachlorocyclopentadiene	2E - 1
Hexachloroethane	4E - 2
Hydrogen cyanide	7E - 1
Hydrogen sulfide	1E - 1
Isobutyl alcohol	1E + 1
Isophorone	7E + 0
Lindane (hexachlorocyclohexane)	See MCL
Maleic hydrazide	2E + 1
Methacrylonitrile	4E - 3
Methomyl	1E + 0
Methyl ethyl ketone	2E + 0
Methyl isobutyl ketone	2E + 0
Methyl parathion	1E - 2
Nickel	7E - 1
Nitric oxide	4E + 0
Nitrobenzene	2E - 2
Nitrogen dioxide	4E + 1
Octamethylpyrophosphoramide	7E - 2
Parathion	1E - 2
Pentachlorobenzene	3E - 2
Pentachloronitrobenzene	1E - 1
Pentachlorophenol	1E + 0
Perchloroethylene (Tetrachloroethylene)	4E - 1
Phenol	1E + 0
Phenylmercuric acetate	3E - 3
Phosphine	1E - 2
Potassium cyanide	2E + 0

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Underground Injection Control Program Guidance No. 66

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Potassium silver cyanide	7E + 0
Pronamide (Kerb)	3E + 0
Pyridine	4E - 2
Selenourea	2E - 1
Silver	See MCL
Silver cyanide	4E + 0
Silvex (2, 4, 5-TP)	3E - 1
Sodium cyanide	1E + 0
Strychnine	1E - 2
Styrene	7E + 0
1, 2, 4, 5-Tetrachlorobenzene	1E - 2
2, 3, 4, 6-Tetrachlorophenol	1E + 0
Tetraethyl lead	4E - 6
Thallic oxide	1E - 2
Thallium acetate	2E - 2
Thallium carbonate	1E - 2
Thallium chloride	1E - 2
Thallium nitrate	2E - 2
Thallium selenite	2E - 2
Thallium sulfate	1E - 2
Thiram	2E - 1
Toluene	1E + 1
1, 2, 4-Trichlorobenzene	7E - 1
1, 1, 1-Trichloroethane	See MCL
1, 1, 2-Trichloroethane	7E + 0
Trichloromonofluoromethane	1E + 1
2, 4, 5-Trichlorophenol	4E + 0
2, 4, 5-Trichlorophenoxy acetic acid (2, 4, 5-T)	See MCL
1, 1, 2-Trichloropropane	2E - 1
1, 2, 3-Trichloropropane	4E - 2
Vanadium pentoxide	7E - 1
Warfarin	1E - 2
Xylene (total)	7E + 1
Zinc cyanide	2E + 0
Zinc phosphide	1E - 2

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Concentration Limits Applicable to "No Migration" Petitions

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Table D  
Health-Based Criteria for Carcinogens

Constituent	Class (A, B, C)	RSD (mg/kg/day)
Acrylamide	B	9E - 6
Acrylonitrile	B	7E - 5
Aldrin	B	2E - 6
Aniline	C	1E - 2
Arsenic	A	See MCL
Benz(a)anthracene	B	1E - 5
Benzene	A	See MCL
Benzidine	A	2E - 7
Benzo(a)pyrene	B	3E - 6
Beryllium	B	7E - 6
Bis(2-chloroethyl) ether	B	3E - 5
Bis(chloromethyl) ether	A	4E - 6
Bis(2-ethylhexyl) phthalate	B	4E - 3
Cadmium	B	See MCL
Carbon tetrachloride	B	See MCL
Chlordane	B	3E - 5
1-Chloro-2, 3 epoxyp propane (Epichlorohydrin)	B	4E - 3
Chloroform	B	6E - 3
Chloromethyl methyl ether	A	4E - 6
Chromium (hexavalent)	A	See MCL
DDD	B	1E - 4
DDE	B	1E - 4
DDT	B	1E - 4
Dibenz(a,h) anthracene	B	7E - 7
1, 2-Dibromo-3-chloropropane	B	2E - 6
1, 2-Dibromoethane	B	--
Dibutyl nitrosamine	B	6E - 6
1, 2-Dichloroethane	B	See MCL
1, 1-Dichloroethylene	C	See MCL
Dichloromethane (Methylene chloride)	B	5E - 3
1, 3-Dichloropropene	B	2E - 4
Dieldrin	B	2E - 6
Diethylnitrosamine	B	2E - 7
Diethylstilbestrol (DES)	A	7E - 8

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Underground Injection Control Program Guidance No. 66

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2, 4-Dinitrotoluene	B	1E - 4
1, 4-Dioxane	B	7E - 3
1, 2-Diphenylhydrazine	B	4E - 5
Ethylene oxide	B	1E - 4
Heptachlor	B	8E - 6
Heptachlor epoxide	B	4E - 6
Hexachlorobenzene	B	2E - 5
Hexachlorobutadiene	C	5E - 3
Hexachlorodibenzo-p-dioxin	B	6E - 9
Hexachloroethane	C	3E - 2
Hydrazine	B	1E - 5
Hydrazine sulfate	B	1E - 5
Lindane (gamma-Hexachlorocyclohexane)	C	See MCL
3-Methylcholanthrene	B	4E - 6
4, 4-Methylene-bis-(2-chloroaniline)	B	2E - 4
Nickel	A	--
Nickel (refinery dust)	A	--
Nickel subsulfide	A	--
2-Nitropropane	B	4E - 6
N-Nitrosodiethanolamine	B	1E - 5
N-Nitrosodimethylamine (Dimethylnitrosamine)	B	7E - 7
N-Nitrosodi-N-propylamine	B	5E - 6
N-Nitroso-N-methylethylamine	B	2E - 6
N-Nitroso-N-methylurea	B	1E - 7
N-Nitroso-pyrrolidine	B	2E - 5
PCBs	B	5E - 6
Pentachloronitrobenzene	C	1E - 3
Perchloroethylene (Tetrachloroethylene)	C	7E - 3
Pronamide (Kerb)	C	--
Reserpine	B	3E - 6
Styrene	B	1E - 3
1, 1, 2, 2-Tetrachloroethane	C	2E - 3
Thiourea	B	5E - 5
Toxaphene	B	See MCL
1, 1, 2-Trichloroethane	C	6E - 3
Trichloroethylene	B	See MCL
2, 4, 6-Trichlorophenol	B	2E - 3

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Concentration Limits Applicable to "No Migration" Petitions

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APPENDIX D: REFERENCES

Water Quality Criteria Documents. November 28, 1980  
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Superfund Public Health Evaluation Manual. EPA/540-1-86-060.  
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Surface Impoundment Clean Closure Guidance Manual, Interim Final.  
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Proposed Rule. April 26, 1988 (53 FR 14892-14900).

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Requirements for Class I Wells; Final Rule. July 26, 1988 (53 FR  
28118-28157).

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Effective Dates; First Third Wastes; Proposed Rule. October 26,  
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seq.).

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Background Document 1: Reference Dose (RfD), Description and Use  
in Health Assessments. Feb 10, 1989.

Background Document 2: EPA Approach for Assessing the Risks  
Associated with Chronic Exposures to Carcinogens. February 10,  
1989.

Background Document 3: ODW Health Advisories. February 10, 1989

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530/SW-89-031, February, 1989.